STABILITY AND CHANGE IN THE DEVELOPMENT OF KNOWLEDGE

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Abstract

This paper is about an entirely new approach to the study of knowledge. As an introductory remark, the classical research operations in the field of cognition are reviewed. Against this background, an application of David Hestenes theory of rotational dynamics is demonstrated with particular reference to text processing. Based on the mechanism of joints and links of the AaO machine, angular displacements and the control of textual movements are topologically presented. In the discussion, it is made evident that the presented approach carries more ecological validity than is reflected through all previous methodological attempts of giving a precise measure of attitude change in the development of text.

Categorisation as the foundation of knowledge

This section is about "the study of behaviour" as the ultimate foundation of concept development as well as the development of skills. Within cognitive psychology and the psychology of learning, it is a widely held opinion that both concepts and skills are developing as a function of awareness, which performs the task of associating facts in a constructive way. Neisser (1967) for example regards them as the expected outcome of the operating processes of association. He takes his point of departure in information processing, which relates to the classical research paradigm of cognition. Central to working within this paradigm is the following assumption:

The function of awareness connects certain task-specific cues with some stated criteria for the observation of appropriate performance behaviour.

This kind of reasoning presupposes the presence of "a law of interaction". On the basis of interactions, it is proposed that networks develop as an expression of mentally generated concepts. Thus, the origin of skills is founded in the statistical function of linearity of cue-relations. However, the source of this kind of thinking can be traced to the Code of Hamurabi (1750 BC). Depending on the degrees of deviation from this code, a subject's behaviour is generating the weights connected with the correct response.
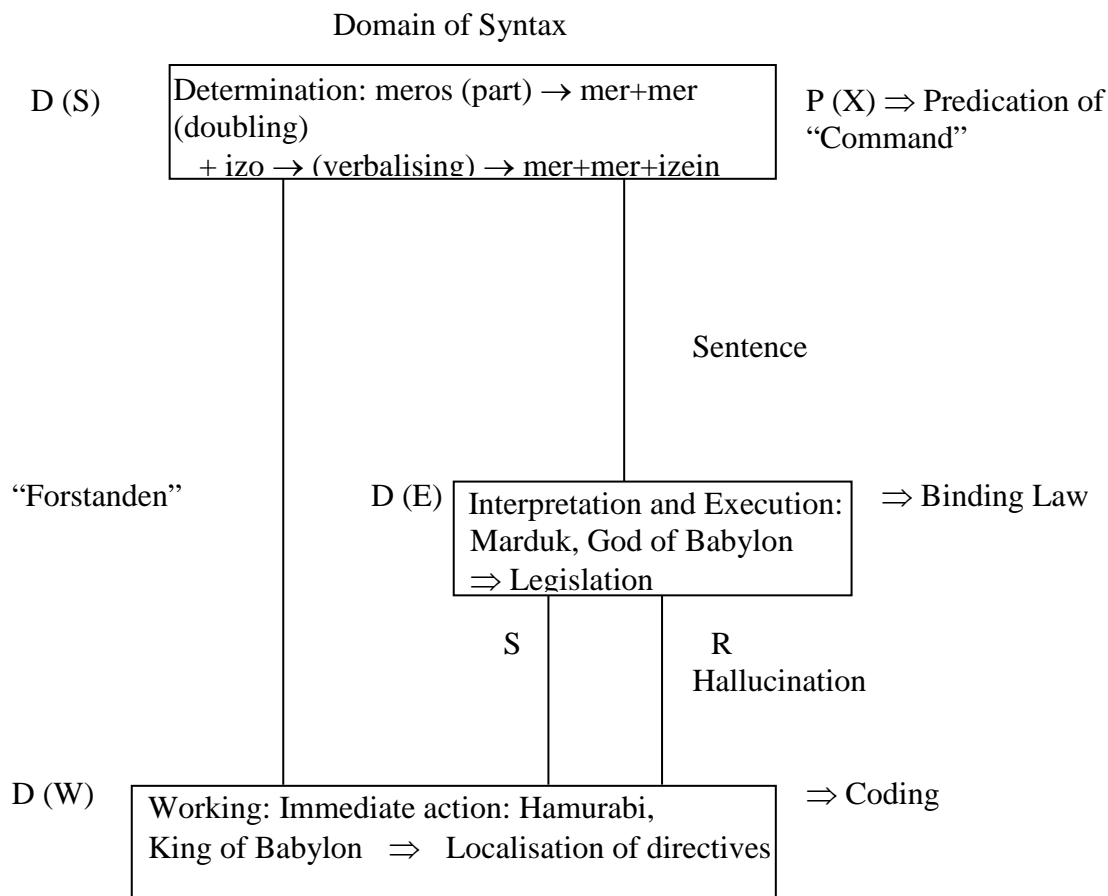
It seems to be instructive to approach the generality of the key function of this idea by relating the picture of Hamurabi and his God Marduk (Jaynes, 1982, p. 199) to the Turing machine as shown in Figure 1. In relating the unquestioned assertion that propositions are the highest form of knowledge (Simon, 1981) to a generalised machine concept brings the constraints of its underlying logic into focus.

A first measure concerns the stipulation of "a subject" that can perform act of discrimination. It is immediately evident that this measure presupposes a covert "a priori condition", which means that the subject is placed into a conflict. It has to decide on which of two actions it should carry out. When asked for a decision, the subject is simultaneously asked to refer to its

memory. Thus, it is always the behavioural foundation of a response on which the correlation is performed.

The presumption, common to all forms of cognitive studies is that a hint or pointer (a finger) exists, that directs the response of the subject. On the first level of the model, presented by Elstrup Rasmussen (1997), this ability is expressed as some filter through which the real world is assimilated. Filtering means that only certain relations are accessible within a particular domain.

Figure 1. The bicameral mind: Julian Jaynes (1976, p.199)

Domain of Syntax

D (S)   Determination: meros (part) → mer+mer
           (doubling)   P (X) ⇒ Predication of
              + izo → (verbalising) → mer+mer+izein   "Command"

                                              Sentence

"Forstanden"   D (E)   Interpretation and Execution: ⇒ Binding Law
                              Marduk, God of Babylon
                              ⇒ Legislation

                        S   R
                                  Hallucination

D (W)   Working: Immediate action: Hamurabi,   ⇒ Coding
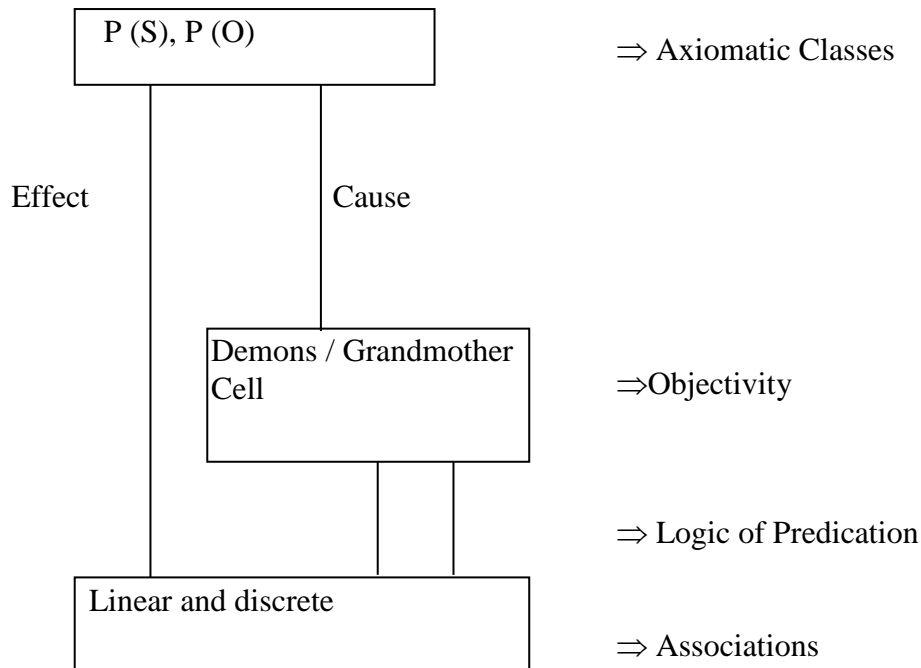   King of Babylon   ⇒   Localisation of directives

The real world is posed to the subject through its senses as a cipher. Binary valued cues are the carriers of real world information that has to be decoded on the basis of the messages of experience. It follows that cues can be used in order to establish a linear discrimination or "cue-structure".

Knowledge as the functional outcome of classification

The "study of classification" evolved from a long contemplation about the "laws of existence" and the "laws of the universe". Basically, classifiers are occupied with an analysis of experience. However, their purpose has been to come to insight and thus to "true" knowledge. The models presented by I. Bierschenk are demonstrations of what kind of instruments are

available for a distinction between properties essential to real objects and properties which depend on the mode of classification. A prototypic machine for classification is given in Figure 2.

Figure 2. Subjective determinism

P (S), P (O)	⇒ Axiomatic Classes

Effect   Cause

Demons / Grandmother Cell	⇒Objectivity

⇒ Logic of Predication

Linear and discrete	

⇒ Associations

Still, the analyses of classification continue to be conducted with the purpose of demonstrating the Gestalt phenomenon as evidence of insight. This kind of studies pertains to the second level of the model developed previously (Elstrup Rasmussen, 1997). It is the basis for the distinctions that can be made with reference to the configurational relations between cues and perceived object. Such relations are designed by translating cues and categories into the determinism of Figure 2. Within the clarified frame of reference of predicate logic, structural assumptions of a statistical kind are utilised in the modelling of knowledge acquisition and skills.

This kind of cue-world relation is very different from the properties and relations ascribed to the objects and organisms at the ability level. The cues of import in determining the statistical relations concern the mental world of concepts. They are constructs, which are conceived of as reasoned representations of the real world. Because of the absence of structural implications, inference and personal interpretations have had great impact on the definition of knowledge and skills (B. Bierschenk, 1995).

Knowledge as the outcome of life processes

Life is the ultimate definition of a biological machine that can produce knowledge and skills. In this respect, the biological machine is different from the Turing machine. Compared to the kind of results expected on the basis of the two preceding sections, the present is entirely different because it takes its departure in processes, sequences, stability and change. In

contrast to the Turing machine, a biological machine is dependent on oscillations in its information pick-up. Therefore, co-ordination, directionality and co-operation are important concepts in the description of knowledge. Point of departure is the text building behaviour and the discontinuities contained in the discourse of a text. Thus, knowledge develops at the edge of uncertainty. Figure 3 presents this kind of machine.
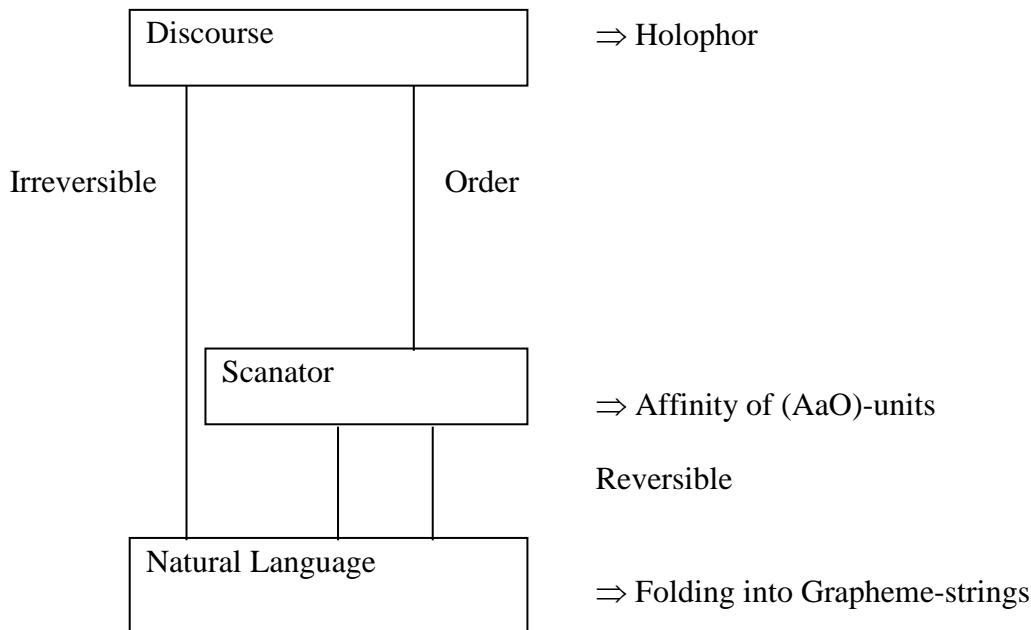
Figure 3.

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┌─────────────────────┐
│ Discourse           │        ⇒ Holophor
└──────┬───────┬──────┘
       │       │
 Irreversible  Order
       │       │
    ┌──┴───────┴───┐
    │ Scanator     │           ⇒ Affinity of (AaO)-units
    └──┬───────┬───┘
       │       │               Reversible
  ┌────┴───────┴──────┐
  │ Natural Language  │         ⇒ Folding into Grapheme-strings
  └───────────────────┘
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Figure 3 provides the relationship that link the macroscopic "discourse" with the microscopic "co-ordinates" of a language space. The parallel trajectories connecting "Scanator" with "Natural Language" concern those physical processes that are reversible. They have the task of carrying out the necessary substitutions by up- and downward moves. These Ups and Downs have been identified with the translations of textual elements in space and time. It follows that a substitution process is establishing temporal symmetry relations. However, the number of configurational constraints remains invariant. The non-parallel trajectories, connecting "Natural Language" with "Discourse" on one hand and "Discourse" with "Scanator" on the other, have been identified with irreversible flow processes. These flows are associated with attitude changes. Thus, flows are changing the internal constraints of the system. This means that the spreading of information by means of a discourse can be equated with temporal asymmetries.

Text plays the central role in the working of Figure 3. The functional units of text building are the AaO's. By analysing text as a dynamic system, malleable couplings of time dependent developments become accessible, which has been demonstrated by I. Bierschenk (1997). The rhythmic working of the Scanator is producing the base for the working of an optimising function in the clustering of textual elements. This function affords the prerequisites for the emergence of novel concepts, which on every level of clustering determines what one is able to know.

As proposed by Elstrup Rasmussen 1996, p. 14), the "Holophor" is the kind of topological layout that makes explicit what the structural relation of the discourse are and how they have evolved during processing. This terminus relates to Pribram's (1971) language of the brain, where he proposed the term hologram. The other part of this term concerns the metaphoric quality of the analysis. Thus a "Holophor" is carrying wholeness.

The terminus "Scanator" has been proposed as concise definition of the AaO-mechanism, which connects the dynamic flow-fields of language over three levels. Moreover, the terminus has also the function maintaining the Scandinavian origin of its methodological and theoretical development (B. Bierschenk, 1995, p. 9).

In adopting the terminology of spinor mathematics, it will be shown that the AaO-units have a certain rotational dynamic. In the dynamics of knowing, these units have the capacity of developing higher-order relations of great variety. However, they can be differentiated on the basis of broken symmetries and topological operations.

A scalar component in the form of radians has been introduced (B. Bierschenk, 1997). Its task is to give a precise definition of articulation in a discourse. It follows that the radians correspond to the rotations in the A- and O-component of the AaO-units. The focus on rotational dynamics and on a geometric description of text building behaviour provides for the linkages and bifurcations resulting from angular displacements. The negentropic control of textual movements will be discussed with reference to the discontinuities of a text example. On the basis of the example, time-dependent morphologies will be presented and discussed.

Knowing as a function of co-ordinate space transformation

The token individual is in the present context a member of a biological system that can come to knowing of itself and its environment. It is important to note that the biological system is conceived of as an abstraction. This means that it is always the individual that abides the ($T \propto M^\rho L^\varepsilon$) law (Kugler & Turvey, 1987, p. 206). It follows that each individual system provides a unique physical context for the expression of the law. On the basis of motor task performances have Kugler and Turvey (1987) demonstrated the operation of the proposed law. Evidence of its operation in connection with text production has been given in B. Bierschenk (1995). Unfolding the configuration of a text implies the identification of its twisting and twining. Twining marks a fold in the development of a helix. Folding is initiated whenever a new variable enters into the process of production. However, twisting marks the appearance of string of graphemes, which includes the formal pronoun ('it'). The result of this processing is demonstrated in Figure 4.
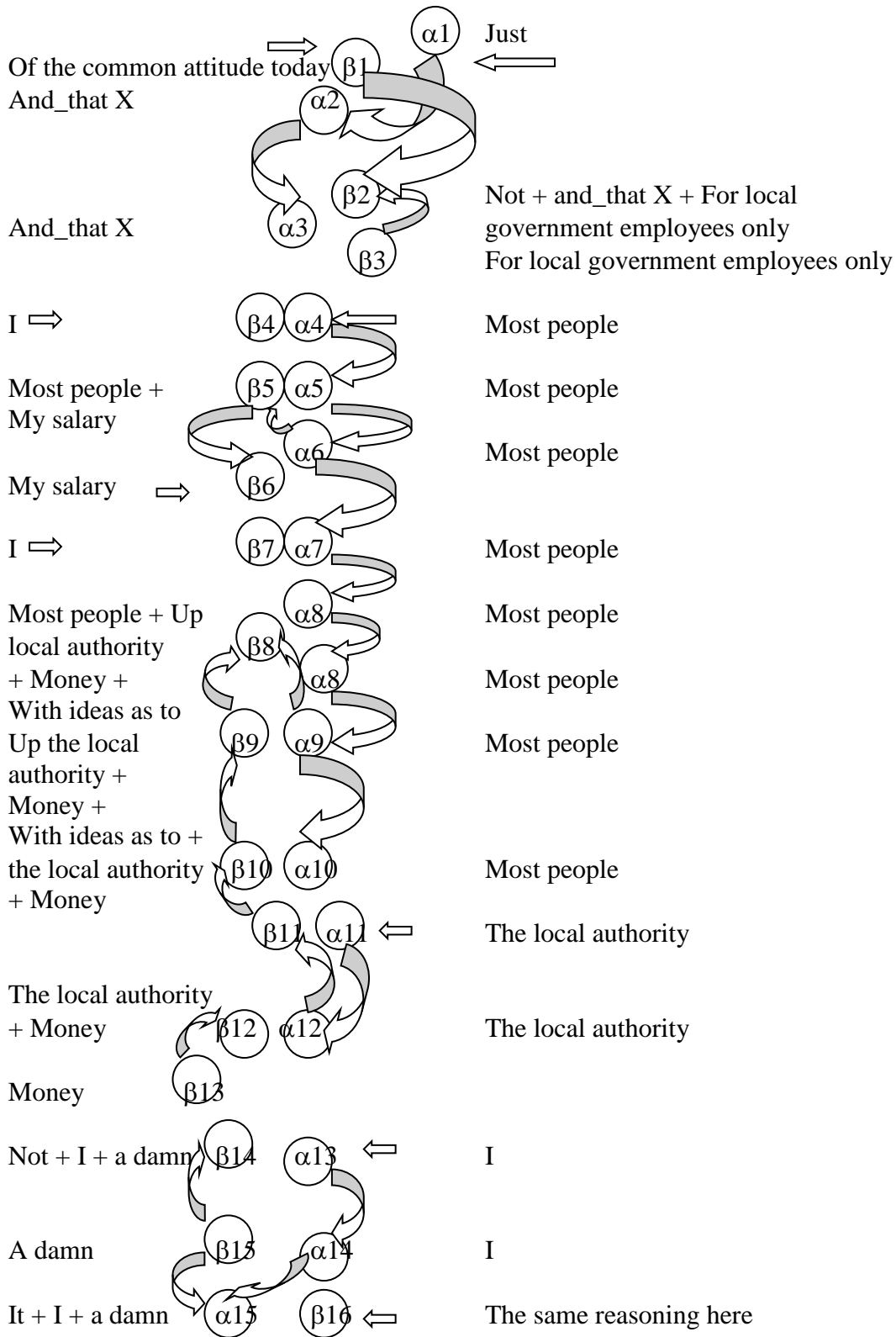
Figure 4. Configuration of the Double Helix

α1 Just

Of the common attitude today β1

And_that X

α2

β2 Not + and_that X + For local
government employees only

And_that X α3

β3 For local government employees only

I ⟹ β4 α4 Most people

Most people + β5 α5 Most people
My salary

α6 Most people

My salary ⟹ β6

I ⟹ β7 α7 Most people

Most people + Up α8 Most people
local authority
+ Money + β8
With ideas as to α8 Most people
Up the local β9 α9 Most people
authority +
Money +
With ideas as to +
the local authority β10 α10 Most people
+ Money

β11 α11 ⟸ The local authority

The local authority
+ Money β12 α12 The local authority

Money β13

Not + I + a damn β14 α13 ⟸ I

A damn β15 α14 I

It + I + a damn α15 β16 ⟸ The same reasoning here

Figure 4 is a demonstration of the dynamics of a text, and that dynamics is the agency through which linkage relations among the α's and the β's are generated, modified or broken. The breaking of a linkage relation is marked by the absence of an arrow. Evidently, a change in the linkage relation concerns a change in the set of states that is more or less significant.

As discussed in B. Bierschenk (1993, p. 6), time enters into the calculations in two different ways. As a parameter, it is incorporated in the definition of a phase. This means that phase is a function of elapsed time. As an organising device, it plays an important role in connecting the direction of time with dynamic processes. Further, it concerns the degrees of displacement of various textual elements that must occur if the expression of particular physical processes is a knowing invariant. In this respect is the choice of a particular individual not arbitrary at all. On the contrary, the choice respects the individual as the unique frame of reference to which different disparities between developing forms and structures can be related. Studying knowing as outcome of text production is a choice that encourages the establishment of temporal morphologies and a concentration on the function played by geometry.

Thus, it is clearly illustrated through Figure 4 that a making and breaking of the links between its elements will strongly influence the attractor states. Some point attractors will simply be more attractive. Crucial for the continuation of the discussion of Figure 4 is the fact that every circle or point represents a possible asymptotic state for the textual system. Thus, dynamic movements are arising from the co-operative interaction and contract on the linkage relations which persist on the trajectory of the A- and B-dimensions. Furthermore, each trajectory uniquely determines the behaviour of the respective component as well as the system in its entirety. In this sense, it is its dynamics that is limiting the number of degrees of freedom and consequently the states to be considered in the description of the system. The next step therefore is to ponder on the base of the textual expression, given in the form of a translation from a Swedish text into English.

Just think of the common attitude today, and that does not go for local government employees only, most people think I have got my salary, why should I bother to come up with ideas as to how the local authority could save money? I don not care a damn. It is the same reasoning here. (Professional translator: Dagny Persson, Lund)

Related to this text has been the newly developed theory of rotational dynamics (Hestenes, 1986), which in essence is the foundation on which the form, function and growth in knowing is discussed. This discussion entails the concept of time as the expression of successively increasing or decreasing rotational velocities. The results, which are the outcome of established constraints on set of the states are shown in the Figures 5 and 6.

Figure 5. Holophor of the B-dimension

Holophor of the B-dimension
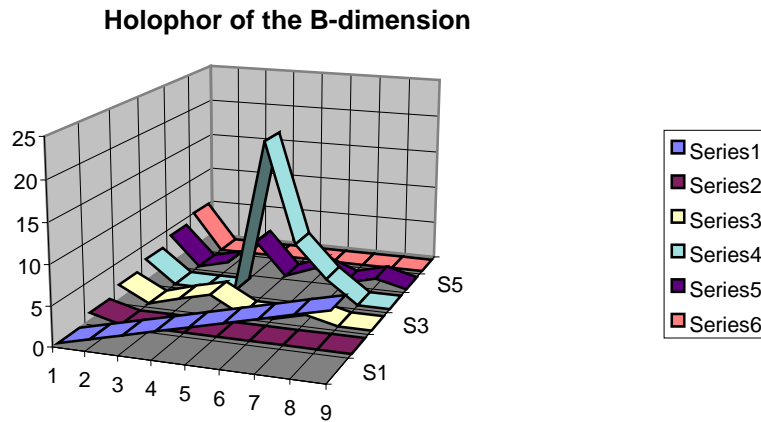
Series 2: Intention
Most People + My Salary   ⇒ {Conviction (2), Accusation (3), Disloyalty (6)}
Physical Anchorage
 in the Tex
t
Series 3: Intention
My Salary   ⇒ {Malfunctioning (4), Fraud (5),
Physical Anchorage   Ortodoxy (6), Prejudice (7)} ⇐ Not a Dam
in the Text   *Physical Anchorage*
                                                         in the Text

Series 4: Intention
I   ⇒ {Appointment (2), Discontent (3),
Physical Anchorage   Sluggishness (5)}   ⇐ Money
in the Text   *Physical Anchorage*
                                                         in the Text
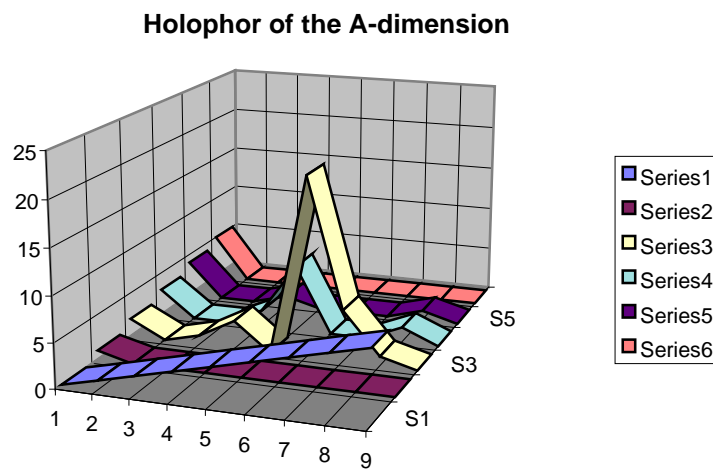
What matters in considering Figure 5 is that a clear distinction can be made between the physical thing and the model of analysis. This means that this distinction can be uphold against the contrary tendency of conceiving natural language from a phenomenological point of view, which is contaminated with naïve realism. Thus, the model that has generated the dimension has also generated a demonstrative definition of what a concept stands for. In comprehending a concept, it must be related to a measuring space that is consistent with the Euclidean properties of a physical space.

The co-ordinate space used in Figure 5 states the geometry structure of the textual system in a fixed format. However, the physical properties of the frame of reference (the token individual) may be obscured by the fact that a fixed format cannot account for the response surface or curvature of the reference space. Because the curvature of a geometric structure is usually time-dependent, relations among physical quantities should be represented as shown in Figure 5.

Compared to the original text, which is of a high-dimensional kind, its alternative topological description is of a low-dimensional kind. This means that two or at most three dimensions are sufficient for a characterisation of its significant invariants. Accordingly, the study of natural language production allows for the extraction of the intention and orientation of a text. With respect to its informational value, it is made evident, that "Malfunctioning" is the deeply embedded concept that gives a hint on what kind of knowing the text producer holds.

Through the causal relationships between Figure 5 and Figure 6, it is also possible to determine the text producer's perspective specificity. Figure 6 demonstrates the fact of a perspective transformation.

Figure 6. Holophor of the A-dimension

Holophor of the A-dimension

Series 2: Intention

Most people	$\Rightarrow$ {Conviction (2), Accusation (3),	
Physical Anchorage	Fraud (5), Ortodoxy (6),	
in the Text	Disloyalty (7)}	$\Leftarrow$ I
		Physical *Anchorage*
		in the Text

Series 3: Intention

Most people	$\Rightarrow$ {Appointment (3), Discontent (4),	
Physical Anchorage	Prejudice (7)}	$\Leftarrow$ I
in the text		*Physical Anchorage*
		in the text

Series 4: Intention

Non	$\Rightarrow$ {Sluggishness (3),	$\Leftarrow$ Non
Physical Anchorage	Prejudice (7),}	*Physical Anchorage*
in the text		*in the textI*

An inspection of the Holophor makes evident a high degree of similarity in the curvature of both dimensions. However, differences have occurred with respect to the central concepts. While "Malfunctioning" is the global state attractor in the preceding Holophor, now it is "Fraud", which has its physical anchorage in "Local authority". A further comparison shows that "Disloyalty" appears at a deeper conceptual level. Here, the notion "depth" refers to the degree of processing as well as to the fact that the concept is relational embedded in a "Prejudice"-factor. Prejudice appears twice and at different positions, which is indicative of a looping in the argumentation.

Discussion

A final comment on the presented method and its outcome concerns the conceptual examination, which requires the explicit formulation of all the presuppositions that can be differentiated. The present analysis must be distinguished from the naïve realism of common sense approaches to text processing. The properties usually perceived and ascribed to a text are totally dependent on the mode of the content analytic. Thus, all the implicit assumptions that goes with the conventional approaches as well as the complexity of subjective experience distracts the social sciences from making progress in the study of mentality.

The other line severing the study of cognition from real progress is the naivety in the scientific realism of psychometrics. Within this field of study and research, it is presumed that the real world can be known only indirectly. Moreover, it is assumed that the world can be represented conceptually by means of constructs. At present, constructs constitute the basis for the distinction between Science and Non-Science. Methodologically, however, the sharp distinction between these two modes has not carried social scientists far enough. Unable to distinguish between the physical thing and its models, social science is still restrained by the iron cage of the mental world concepts.

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